

N91-14977 

MOLECULES IN AN INFRARED CIRRUS CLOUD

Horst Meyerdierks* and Nathalie Brouillet**

* Radioastronomisches Institut der Universität Bonn.

Auf dem Hügel 71, D-5300 Bonn, Fed. Rep. of Germany

** Observatoire de l'Université de Bordeaux I,

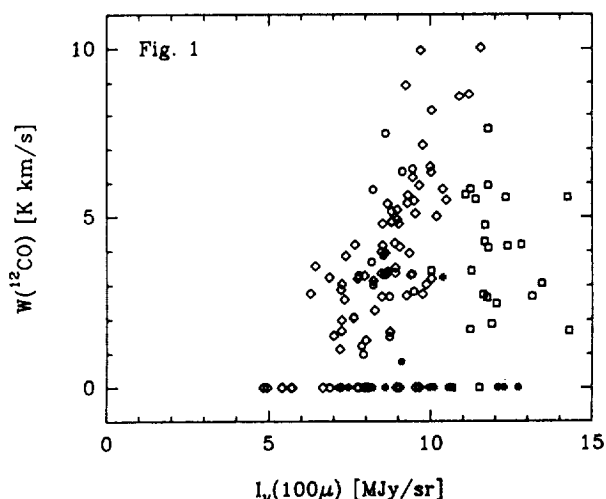
B.P. 21, F-33270 Floirac, France

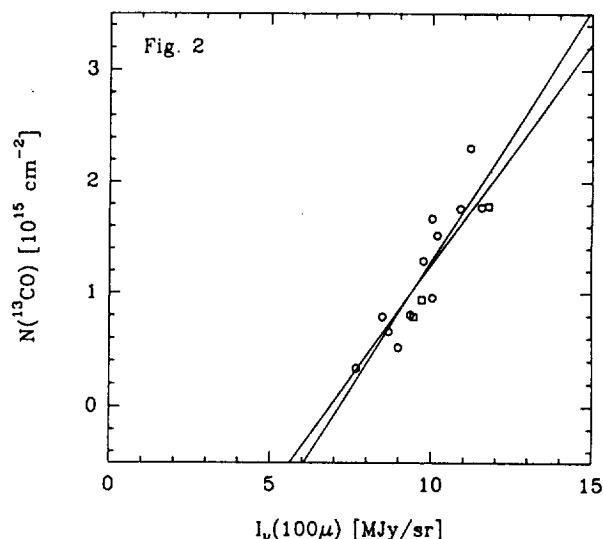
High latitude dark and bright nebulae were already catalogued by Lynds (1962, 1965) and re-detected in the 100 μm band of IRAS (Low et al. 1984). CO was detected in a number of high-latitude clouds (e.g. Goerigk et al. 1983, Magnani et al. 1985). A prominent feature at 100 μm is the Polar Loop (e.g. Wesselius and Fejes 1973, "Polar Ridge"). It is expanding at a velocity of 5 or 10 km/s (Heithausen and Meyerdierks 1987). One of the clouds that form the Polar Loop was observed in the 1_{10-111} 4.8 GHz transition of formaldehyde and in the J=1-0 transitions of ^{12}CO and ^{13}CO at 115 GHz and 110 GHz resp.

The cloud, which has an extent of 2.5° by 4° , consists of several filaments 1° or 2° long and 0.5° wide. From the correlation of IRAS 60 μm and 100 μm intensities we derive a colour temperature of the dust of 21 K and a maximum optical depth of $3 \cdot 10^{-4}$ (assuming $\tau \propto \nu^2$). At one local maximum of the 100 μm intensity, the hyperfine structure of formaldehyde could be resolved. While the H_2CO column density is $(4.4 \pm 2.0) \cdot 10^{13} \text{ cm}^{-2}$, the excitation temperature of 2.43 K implies a gas density of $(2 \pm 1) \cdot 10^5 \text{ cm}^{-3}$ for kinetic temperatures of 10 to 20 K according to Garrison et al. (1975). Maps of this region in H_2CO and CO show the size of the molecular clump to be $7'$. LTE calculations for the observed CO isotopes (cf. Dickman 1978) result

in a peak ^{13}CO column density of $(2.3 \pm 0.8) \cdot 10^{15} \text{ cm}^{-2}$. Converting this to H_2 column density (Dickman) and assuming a distance of 100 pc, the H_2 density should be 2000 cm^{-3} . Obviously the molecule distribution is very clumpy on a scale of less than 1 pc and the observations suffer from beam dilution ($3'$ and $4.4'$ beams).

Since the infrared optical depth is small, the 100 μm intensity can be used as a measure of dust column density. Figure 1 compares this with the observed ^{12}CO line integral. Different





where dense clumps are on the line of sight (i.e. where ^{13}CO is detected), is the molecular column density comparable to the atomic one of the surrounding, less dense envelope. This is demonstrated by figure 2, which shows the correlation of ^{13}CO column density and $100\ \mu\text{m}$ intensity. Roughly half of the dust column density seems to be related to non-molecular gas even at the peak molecular column density.

Finally, the stability of the molecular clump described above can be considered. At an assumed distance of 100 pc the H_2 mass would be $0.6\ M_{\odot}$, while the virial mass for a radius of 0.1 pc and a line width of 1.3 km/s would be $35\ M_{\odot}$. Thus the clump is anything but gravitationally bound and will probably disperse on a time scale of $6 \cdot 10^4$ years. Similarly, the filaments which would be 1 pc across would disperse in $3 \cdot 10^5$ years.

It remains to be seen, if this transient nature is a general property of cirrus clouds. The cloud investigated here may well be special because it belongs to an expanding loop. On the other hand, shocks moving through the interstellar medium may hold a key to the understanding of the filamentary morphology of the infrared cirrus.

References:

- de Vries, H.W., Heithausen, A., Thaddeus, P.: 1987, *Astrophys. J.* **319**, 723
 Dickman, R.L.: 1978, *Astrophys. J. Suppl.* **37**, 407
 Goerigk, W., et al.: 1983, *Astron. Astrophys.* **120**, 63
 Garrison, B., et al.: 1975, *Astrophys. J.* **200**, L175
 Heithausen, A., Meyerderks, H.: 1987, *Mitt. Astron. Ges.* **70**, 417
 Low, F.J., et al.: 1984, *Astrophys. J.* **278**, L19
 Lynds, B.T.: 1962, *Astrophys. J. Suppl.* **7** 1
 Lynds, B.T.: 1965, *Astrophys. J. Suppl.* **12** 163
 Magnani, L., Blitz, L., Mundy, L.: 1985, *Astrophys. J.* **295** 402
 Wesselius, P.R., Fejes, I.: 1973, *Astron. Astrophys.* **24** 15